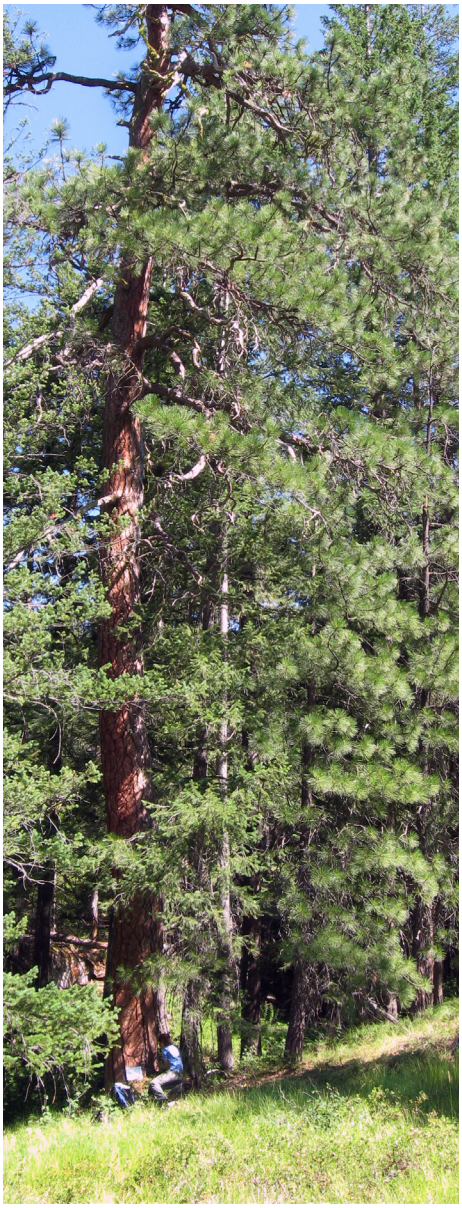
North Cascades Resource Brief

National Park Service
U.S. Department of the Interior

North Cascades
National Park Complex



TOP: Using an increment bore to age a fire-scarred ponderosa pine near Coon Lake

Fire-dependent Ecosystems

Fire plays an integral role in North Cascades ecosystems, shaping vegetation structure and composition, altering soil geochemistry, and influencing hydrologic cycles. It creates openings in forested areas, provides critical habitat for wildlife and pioneering species, and reduces downed woody fuel loads that contribute to higher severity fires. Many ecosystems in the North Cascades would be significantly different without fire; hence, they are fire dependent.

Status and Trends

Ponderosa pine stands are perhaps the most prominent examples of fire-dependent ecosystems in the North Cascades. Ponderosa pine stands depend upon frequent non-lethal ground fires in order to maintain themselves as open, park-like stands. Ponderosa pine trees have several features that make them particularly adapted to withstand low-intensity fires; including thick bark, self-pruning lower branches that would otherwise serve as ladder fuels to the canopy, and deep roots that are protected from fire. Ponderosa pine needles on the ground facilitate the spread of non-lethal fires, and inhibit the germination of understory plants that can intensify fire behavior.

Without fire, ponderosa pine is outcompeted by the more shade-tolerant Douglas-fir. Shrubs and seedlings fill in the understory, enabling Douglas-fir seedlings to thrive. Eventually the Douglas-fir trees overtake the ponderosa pine, filling in the canopy and shading the pines out. Dead and downed wood accumulates at the bases of trees and in fuel jackpots, which increase the potential for higher intensity ground fires. The downed wood, shrubs, seedlings and dead branches also act as ladder fuels that can carry fire into the canopy and from tree to tree as crown fire. Although ponderosa pine trees can survive low-intensity ground fires, they are killed by higher intensity ground fires and crown fires.

In the North Cascades, ponderosa pine trees are a substantial component of the dry, low elevation forests of Stehekin, where they are co-dominant with Douglas-fir. Douglas-fir has always been the predominant species in Stehekin, however, ponderosa pine was historically more common than Douglas-fir on the most arid sites. By comparing stands dominated by ponderosa pine around Stehekin to ponderosa pine forests nearby (e.g., Wright & Agee, 2004), we estimate that fires historically occurred every fifteen to forty years on these sites.

We are currently using fire scars and stand age data to determine the fire histories for all of the stands in the Douglas-fir / ponderosa pine forests of Stehekin. Although the results are not ready yet, we are confident that the remaining ponderosa pine dominated stands have missed at least one fire return interval since the early 1900s when the U.S. Forest Service began its policy of fire suppression. The fire management team is actively thinning and burning in Stehekin to reduce hazard fuels and enhance the low-severity fire regime characteristics of stands dominated by ponderosa pine.

Whitebark pine stands are another example of fire-dependent ecosystems in The North Cascades. Whitebark pine trees are better adapted to surviving low-severity fires, and more successful at regenerating after stand-replacing fires than other high elevation tree species.

Contact: Karen_Kopper@nps.gov

References:

Franklin, J. F., & Dyrness, C. T. (1988). Natural Vegetation of Oregon and Washington. Oregon State University Press.

Wright, C. S., & Agee, J. K. (2004). Fire and vegetation history in the eastern Cascade Mountains, Washington. Ecological Applications, 14:2.

They have somewhat thicker bark, thinner crowns and deeper roots than their competitors (e.g., subalpine fir, lodgepole pine). In upper subalpine meadows where trees are sparse and low-severity fires are more probable, these adaptations favor whitebark pine survival. In denser stands, where stand-replacing events are most common, whitebark pines are competive recolonizers. They are successful recolonizers because they regenerate almost exclusively from seed caches left by the Clark's nutcrackers that carry and cache whitebark pine seeds much further than the wind-dispersed seeds of competing trees.

Whitebark pine occurs in subalpine meadows throughout most of the ridges on the eastside of the North Cascades, both sides of Ross Lake and as far west as Copper Ridge and Cascade Pass.

Unfortunately, these stands, like most in the Northwest, are infested by white pine blister rust, a fungal disease caused by an introduced pathogen that is lethal in seedlings and weakens mature trees. Regeneration strategies are under investigation by the park's botanist. Although prescribed fire is an approach taken to restore whitebark pine stands in some areas, it is considered too risky in the North Cascades where even low- severity fire may kill pines weakened by white pine blister rust, and there may not be a large enough seed source for recolonization.

Lodgepole pine stands are also fire dependent. Fires are typically moderate to high-severity events that kill lodgepole pine trees. The pines benefit from fire by being successful recolonizers. They grow quickly and create dense stands on sites that are less favorable to other species. In areas where fires are common the majority of their cones are serotinous, whereas in areas where fires are not the primary cause of mortality, fewer of their cones require fire to release their seeds. In many cases mountain pine beetles also play a role in lodgepole pine regeneration. The beetles attack old and weak trees in mature lodgepole pine stands creating numerous snags and downed trees within the stands. The accumulation of standing and downed fuel increases the potential for higher

TOP: Mountain pine beetles have infested this lodgepole pine stand on the eastside of Ross Lake

intensity fires, thus perpetuating the cycle of fire and regeneration. Without fire and/or beetles, lodgepole pine trees would eventually be overtaken by later-successional species.

Lodgepole pine forests are prevalent around Ross Lake. Many of the stands have already succumbed to mountain pine beetles, and thus, are primed for wildfire (photo above). The park's fire management plan identifies these stands as excellent opportunities for wildland fire use because fire will benefit the lodgepole pine stands without jeopardizing lives and structures.

Discussion

Fire-dependent ecosystems face varied and uncertain changes in the midst of global warming. Fires are expected to be larger and more severe in the West due to warmer and drier summers. Lodgepole pine stands may benefit from more severe fires, however it is unlikely that whitebark pine and ponderosa pine stands will fare as well. Ponderosa and whitebark pine can survive low-severity fires, but are killed by higher severity events. Although whitebark pine is a competitive recolonizer, like lodgepole pine, there may not be a large or varied enough seed source to maintain the population.

Fire and resource managers need to anticipate how climate change will impact all of the ecosystems in the North Cascades. Should fire-adapted species be planted in burned areas to assist species migration? Does this fit with the NPS mission to preserve and protect ecosystems, or is this type of human intervention inappropriate in the national parks? How will species adapt to changing climate conditions and new interactions between species? These are the types of questions we hope to answer through research and collaboration in the future.